

# ***FAST site EMU CSC test results – a global view from ROOT***



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*Fermilab July 23, 2004*



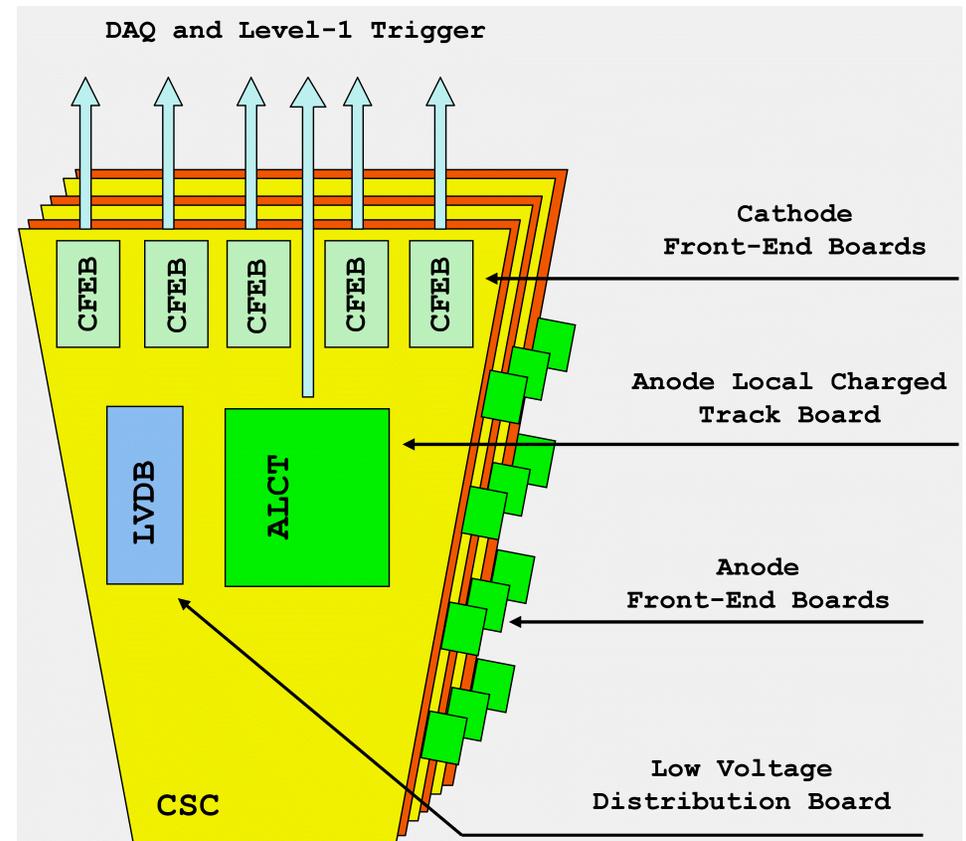
- **EMU CSC provides:**
  - **BX identification with efficiency  $> 92\%$**
  - **muon trigger primitives (CSC local tracks) for Level-1 trigger**
  - **high precision coordinate measurement**



## CMS Endcap Muon Cathode Strip Chambers (EMU CSC)

- **Each CSC:**

- 6-layer, 2-coordinate multiwire proportional cathode strip chamber
- anode wires in the azimuthal direction, cathode strips in the radial direction
- anode (AFEB) and cathode (CFEB) front-end boards
- on chamber Anode Local Charged Track board (ALCT)
- Low Voltage Distribution Board
- located on the iron disks of the flux return yoke of the CMS magnet





## ***CSC in Final Assembly & Test Sites (FAST)***

- Fermilab - CSC parts production and CSC assembly (for UF and UCLA FAST sites)
- OSU,UCLA,CMU,UW - front-end electronics
- Front-end installation and **CSC tests** at FAST sites in **USA** (UF,UCLA), **China** (IHEP, includes CSC assembly), **Russia** (PNPI, includes CSC assembly)
- The same set of tests at **CERN** (ISR) after CSCs arrive from FAST sites
- One more limited set of tests at SX5 (**CERN**), CSC installed on iron disks



## ***CSC tests in numbers***

- **Total of ~410 CSCs of 6 types (by size and by # of the anode channels)**
- **~170,000 anode channels and ~200,000 cathode channels**
- **Test results are in text files (tables) and pictures (Postscript) for each CSC, stored on Web pages of each FAST site (no DB) in US, China, Russia and CERN. Raw data have not been stored.**
- **On Web ~28 tests (~90 tables) per CSC**
- **Tables from 17 tests (~ 87 parameters) were selected to go to the ROOT tree**



- **Goals:**

- get distributions of the test results for all chambers in all FAST sites, including CERN (ISR and SX5)
- compare results for each chamber, cathode strip, anode wire group (ISR vs FAST sites, SX5 vs ISR)
- monitor CSC stability on disks at SX5

- **How to:**

- download (automatically) only the tables and make a ROOT tree for further analysis in ROOT



## *FAST site CSC test results - global presentation in ROOT (cont'd)*

- **Problems with input data :**
  - cases of deviations from standards (folder names, e.g. CSC type and ID number, file names and extensions, data format)
  - missing files ? - > email to FAST sites
- **Solutions:**
  - complicated scripts to download files
  - convert results to the standard form
- **No such problems for the test results stored in a database**



## *FAST site CSC test results - global presentation in ROOT (cont'd)*

- **The ROOT tree making code :**
  - based on ROOT example of a Tree with an Event and Track Classes
  - Event Header - > CSC chamber, includes:
    - FAST site ID (UF,UCLA,IHEP,PNPI,ISR,SX5)
    - CSC type
    - CSC ID
    - CSC location on disk in SX5
    - # of CSC objects (test type dependent)
    - ...
  - Event Track - > CSC object for each test result (example of data members - CSC layer, wire or strip, test result parameter)
  - understanding what should be in data members of object is crucial to minimize the number of classes



## *FAST site CSC test results - global presentation in ROOT (cont'd)*

- **The ROOT tree making code (cont'd) :**
  - use TClonesArray of identical objects (as in ROOT example) to present the table of results (example – test result vs layer and wire/strip)
  - maximum branch split level to allow a quick look at the tree by the ROOT tree viewer for debugging
  - add a FileReaderEvent Class to read in the tables with test results and to make TClonesArray objects
  - for EMU CSC FAST tests a ROOT tree has a size of ~ 20 MB for ~ 524 CSCs with the test results grouped into the objects of 16 classes with up to 20 data members per class
  - future development - shell scripts to automate the code writing (except FileReaderEvent Class methods which are detector specific)



## *FAST site CSC test results - global presentation in ROOT (cont'd)*

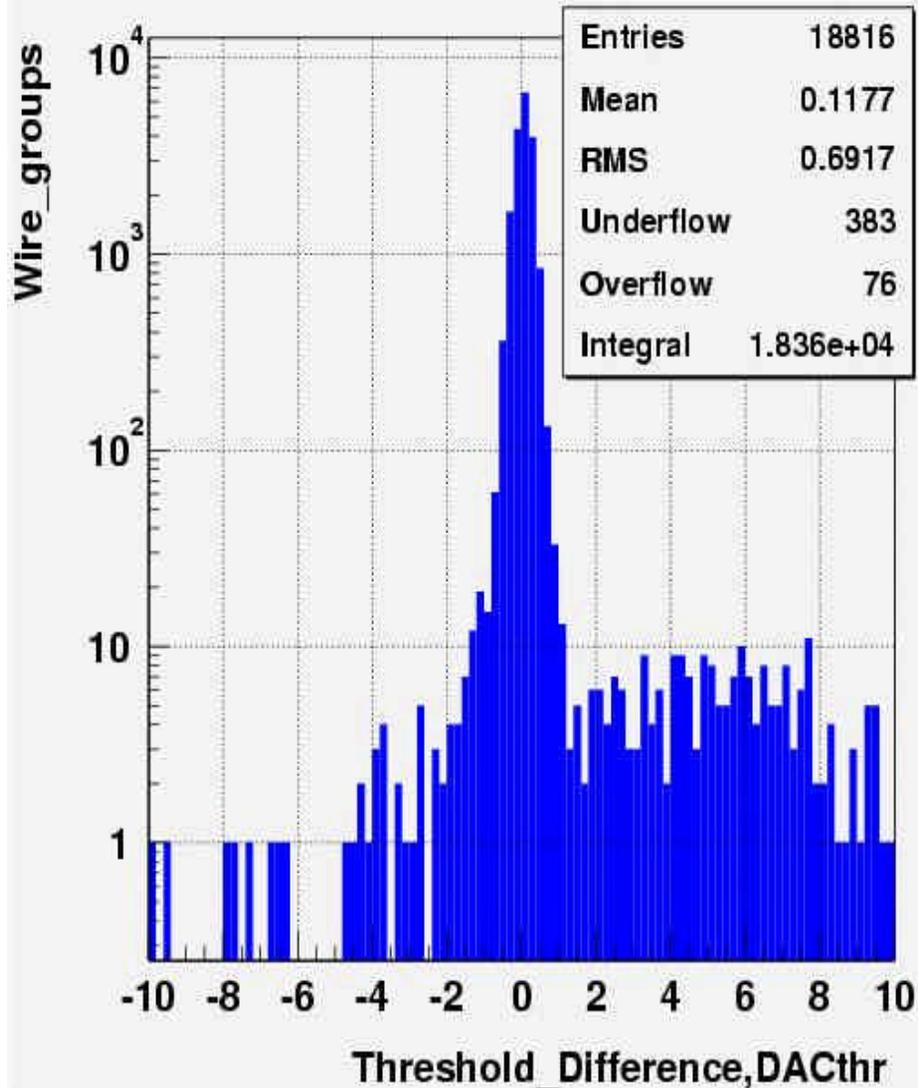
- **The ROOT tree analysis code :**
  - based on ROOT example of using TTree:MakeClass to produce MyClass.C and MyClass.h
  - uses shared library created during the ROOT tree making code compilation and linking
  - the code includes choice of pictures (1D, 2D), their location on the page and # of pages in output Postscript file; also choice of data members and its limits to be plotted; simple selection criteria (CSC type, layer #)
  - all this is controlled by input command text file and scripts
  - future development - put it on Web (use of "CARROT"?) to allow user to do his own simple analysis



# Examples of the test result distributions

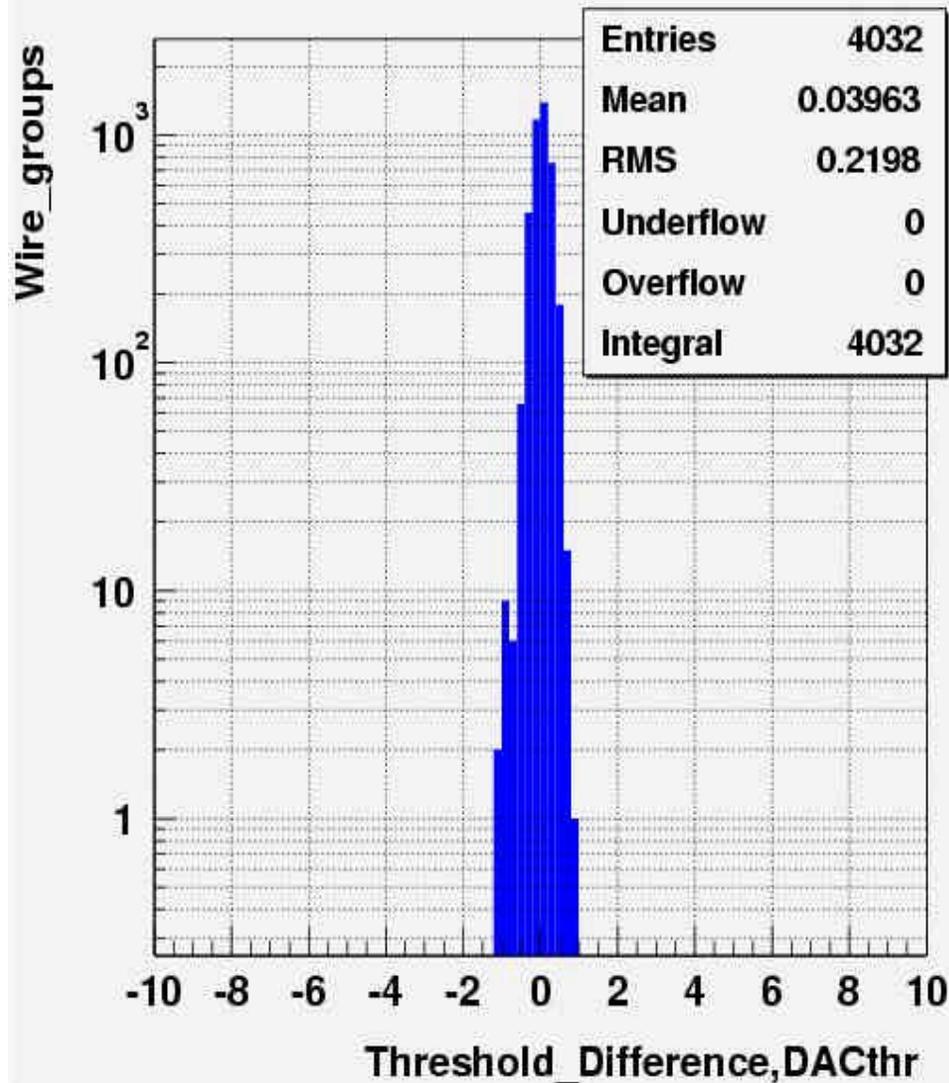
EMU\_CSC\_SX5-ISR\_ME234.2\_TEST\_13\_02

Anode\_Channel\_Threshold\_Qin\_29.8fC\_Difference



EMU\_CSC\_SX5-ISR\_ME2.1\_TEST\_13\_02

Anode\_Channel\_Threshold\_Qin\_29.8fC\_Difference

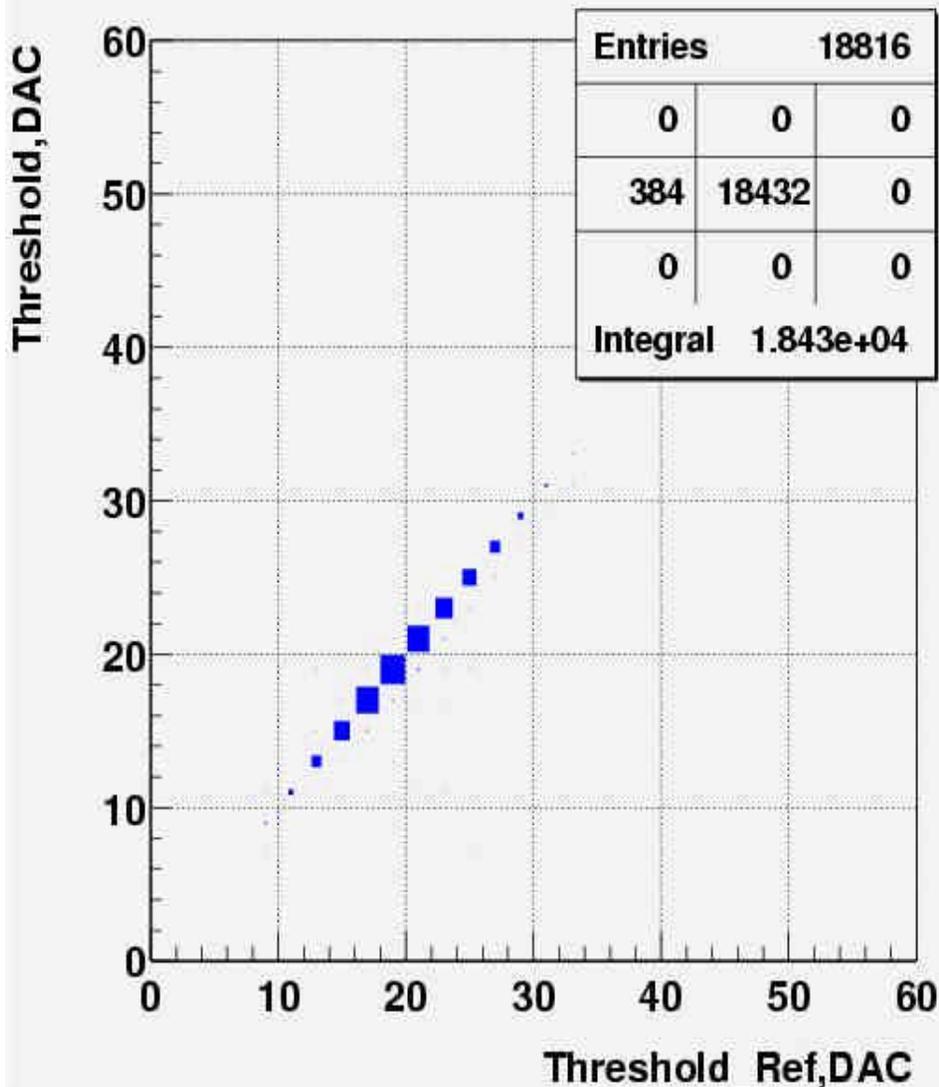




# Examples of the test result distributions

EMU\_CSC\_SX5-ISR\_ME234.2\_TEST\_13\_02

Anode\_threshold\_Qin=29.8fC



EMU\_CSC\_SX5-ISR\_ME2.1\_TEST\_13\_02

Anode\_threshold\_Qin=29.8fC

